



# Weather Impact

## Sub-seasonal forecasting for agriculture in Bangladesh

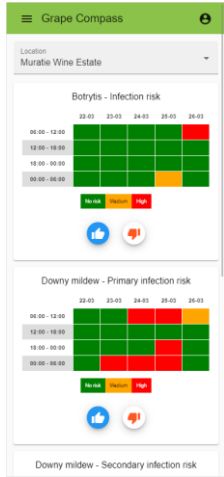
*7 June 2023*

*Bob Ammerlaan  
Weather Impact*



# Weather Impact

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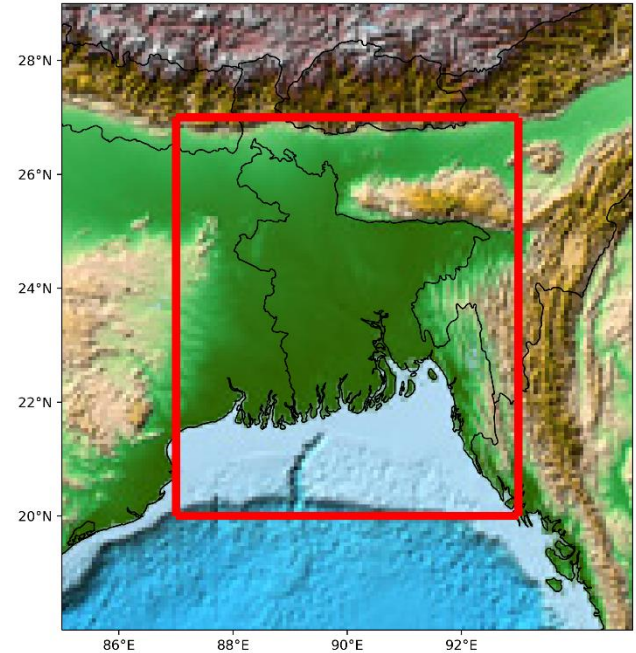


# Introduction



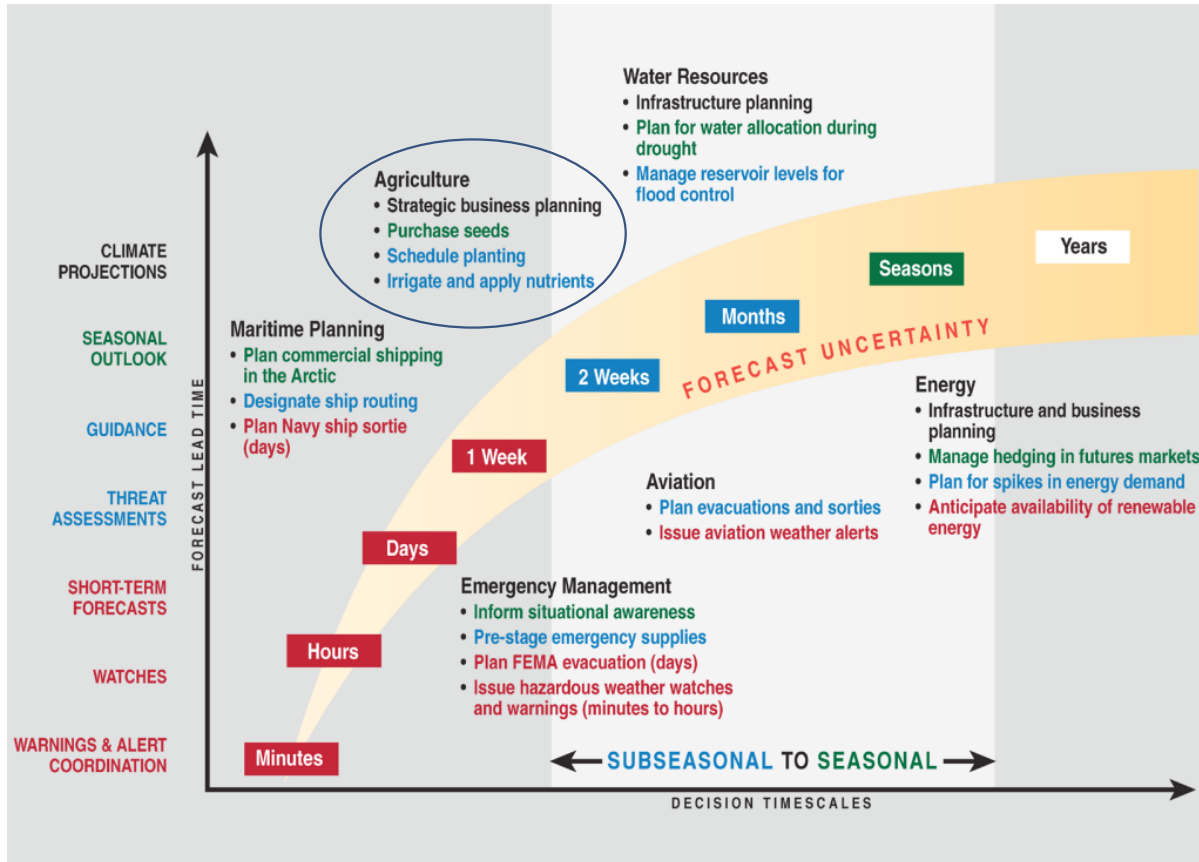
## Weather Impact

- Bangladesh
- #7 in Global Climate Risk Index (CRI) 2000-2019<sup>1</sup>
- Department of Agricultural Extension (DAE)
- Bangladesh Meteorological Department (BMD)



<sup>1</sup>Eckstein *et al.*, 2021

# Why S2S forecasting?



# Weather Impact

- Risk reduction
- Strategic decisions
- Long term planning

Adapted from:  
Earth System Prediction  
Capability Office

# S2S4Agri

- Sub-seasonal to seasonal (S2S) forecasts for Agriculture
- September 2022 - December 2023
- Carried out by
  - Weather Impact
  - Wageningen Environmental Research
  - Digital innovation for Impact
  - Supported by Royal Netherlands Meteorological Institute (KNMI)

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# S2S skill analysis

- Comparison models with BMD observations
  - Weekly average (temperature) / sum (rainfall)
  - Downscaled to 0.05 degree resolution
- Multi-model combinations
  - Combination of 2 - 6 different models
- Calibration techniques
- Upscaling to district/division

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Models (EC MARS)	Models (IRI DL)
ECMWF	<i>NCEP CFSv2</i>
NCEP CFSv2	ECCC
ECCC	ESRL
BoM	GMAO
UKMO	NRL
MeteoFrance	RSMAS
JMA	
CMA	
KMA	
HMCR	
ISAC-CNR	
IAP-CAS	

# S2S skill analysis

- Calibration techniques
- Regression
  - BC Ensemble Mean
  - Random Forest
- Calibration
  - Extended Logistic Regression
  - Member count

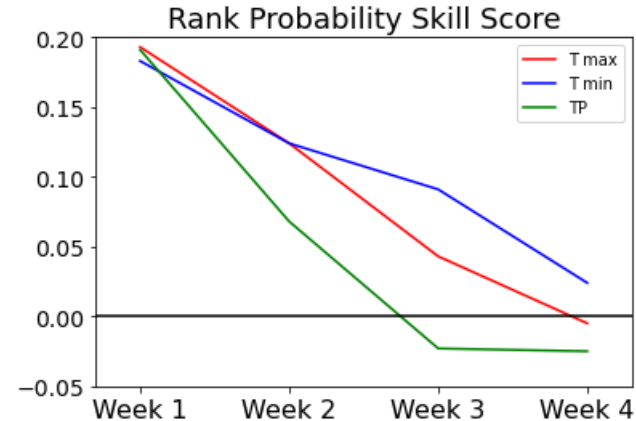
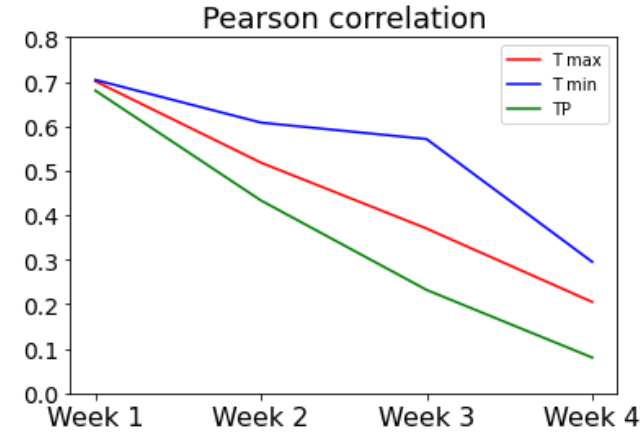
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Regression	Calibration
Random Forest	Random Forest
Poisson Regression	Extended Logistic Regression
Multiple Linear Regression	Probabilistic Output Extended Learning Machine
Ridge Regression	MultiLayer Perceptron
Gamma Regression	Naive Bayes
Extended Learning Machine	Member count
MultiLayer Perceptron	
Ensemble mean	
Bias corrected ensemble mean	

# S2S skill analysis

- Multi-model combinations
  - ECMWF/NCEP/ECCC/JMA/KMA/CMA
- Adding models can increase skill
  - Low amount of datapoints remains
- Categorical forecast (BN/NN/AN)
  - Temperature skillful up to week 4
  - Precipitation skillful up to week 3

## Weather Impact

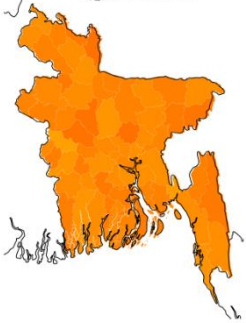




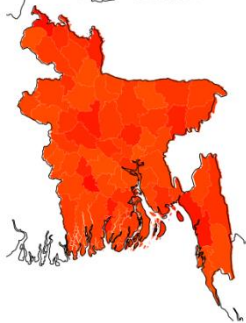
# S2S skill analysis

- Upscaling to division increases skill
  - District: similar skill to grid-grid comparison
  - Skillful forecast throughout the season possible
  - RPSS week 3+4 combined (yearly averaged)

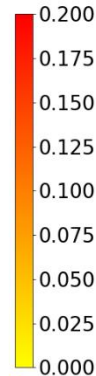
Maximum temperature



Minimum temperature



Precipitation



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# Operational forecast

- Weekly forecast
  - Week 1, 2 and 3+4
  - Temperature and precipitation
- Multi-model combination
  - ECMWF
  - NCEP CFSv2
  - ECCO
  - Other models in future?
- District level output
- Bulletin

# Weather Impact



Issue Date: 17 March 2023

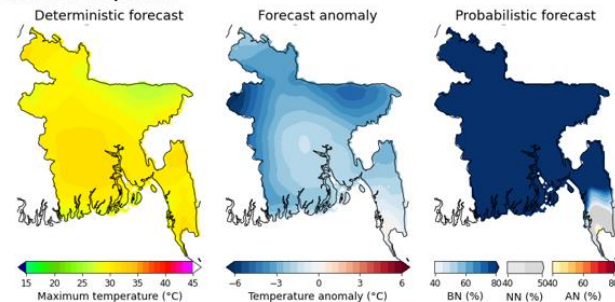
Subject: Experimental sub-seasonal forecast for Bangladesh during 17.03.2023 to 13.04.2023

## 1. Weather Forecast for week 1 (Period: 17.03.2023 to 23.03.2023)

### 1.1 Significant Information

- The maximum and minimum temperatures are likely to be below normal.
- The rainfalls are likely to be normal to above normal in the western part of the country and normal to below normal in the eastern part of the country.

### 1.2 Maximum Temperature

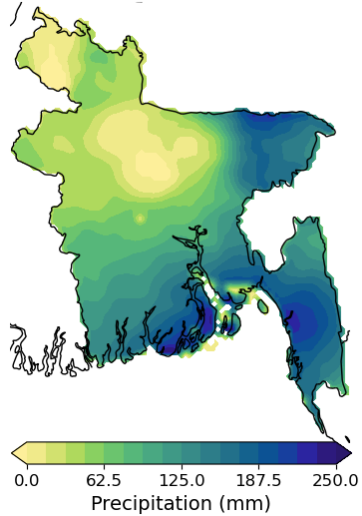


### 1.3 Minimum Temperature



# Visualisation and interpretation

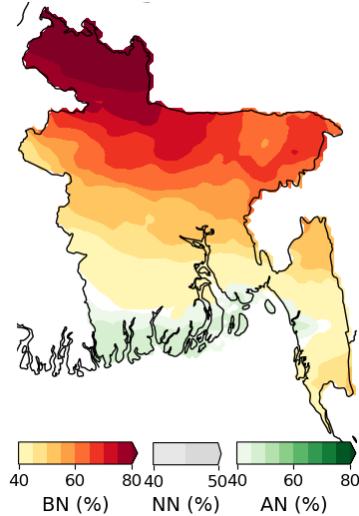
Deterministic forecast



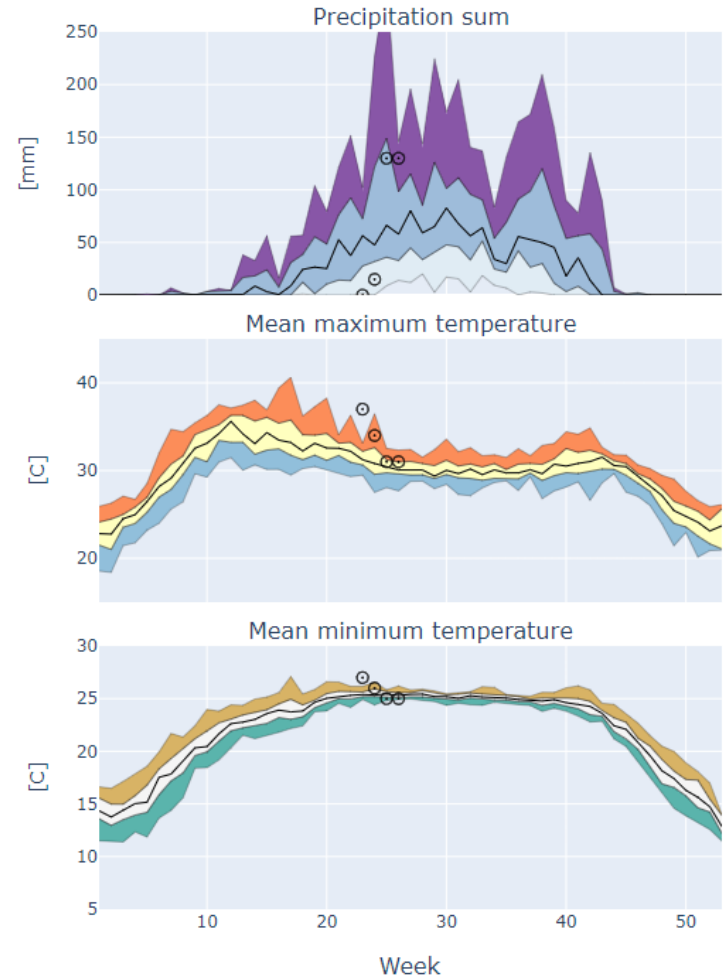
Forecast anomaly



Probabilistic forecast



Climatology and S2S forecast for Khulna



# S2S training

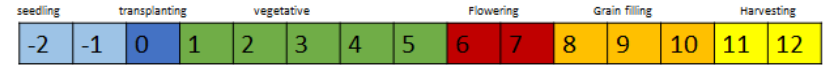




# From forecast to advice

- Translate S2S forecast into advice
- Determine
  1. Crop calendar
  2. Important activities
  3. Weather dependency!
  4. Lead time

Calendar for crop X, Kharif-I



Activities	Transplanting of crop seedlings	Management of fungal disease X during late vegetative stage
Lead time	4 weeks for seedbed preparation and seeding	3 weeks for ordering fungicides and labour for activities
S2S indicator	Depends mainly on precipitation amount	Driven by temperature and humidity
Threshold for indicator	50mm of precipitation in one week	Average weekly temperature above 33C with humidity > 80%
Prediction reliability/skill	Reliable, high S2S skill	Less reliable. Only issue after two consecutive S2S forecasts



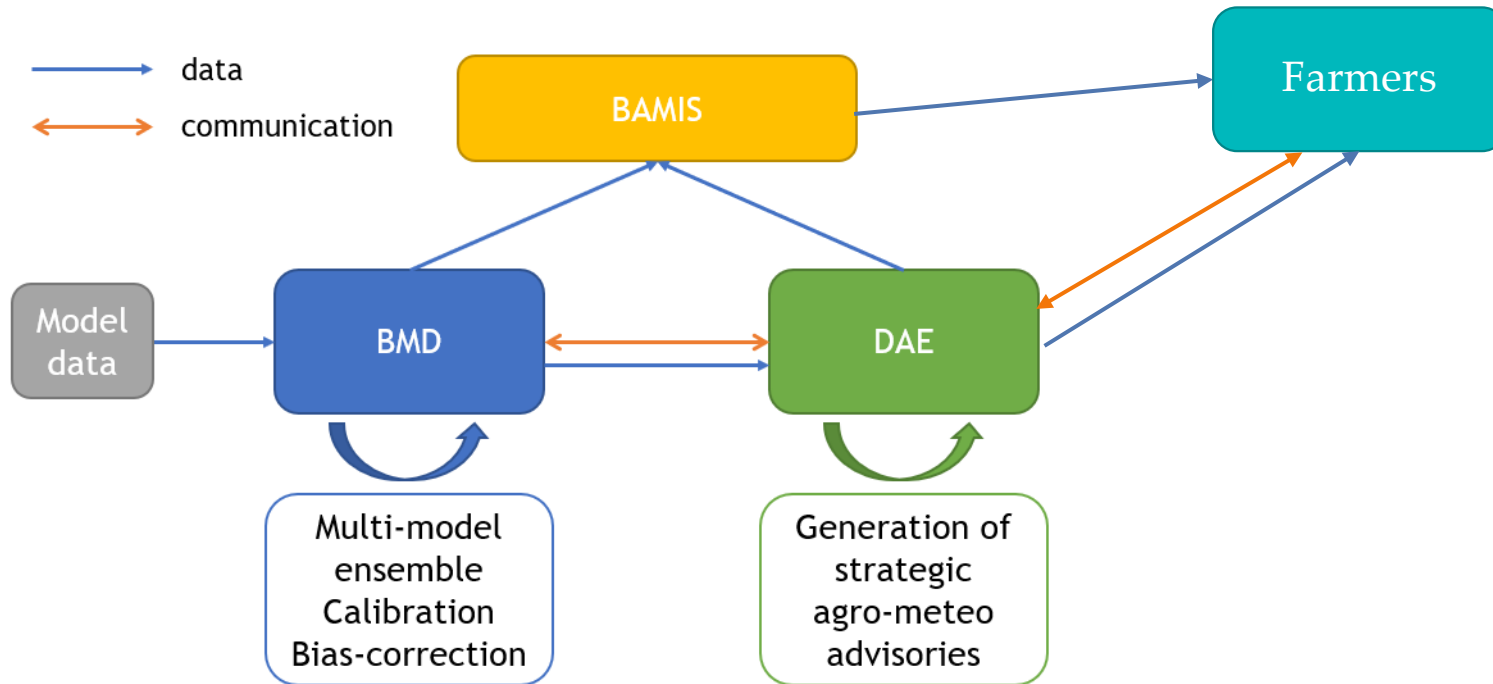
# Field tests

- Validation of S2S forecast and advice with farmers
  - Farmers have experience with weather information
- Use cases
  - Amon rice planting
  - Flowering of mango
- Questions:
  - Is forecast useful to farmers?
  - Is forecast skillful enough?
  - Forecast data vs. advice



# Operational procedure

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# Conclusion

- Experimental S2S system implemented in Bangladesh
  - High expertise level at BMD
- Skillful forecast up to 3 weeks (precipitation) and 4 weeks (temperature) possible
- Currently operated by Bangladesh Meteorological Department, with support of Weather Impact
- Output data is translated to agriculture
  - Tests will be carried out this summer

# Acknowledgements

Weather Impact

- Dr. Nabansu Chattopadhyay
  - International consultant to DAE
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- Dr. Mizanur Rahman
  - National consultant to DAE
- Mr. Sadman Sadek
  - CEO, Digital Innovation for Impact
- Dr. Allard de Wit
  - Senior Researcher, Wageningen Environmental Research



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*7 June 2023*

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